# EXHIBIT 6

[redacted]

[redacted]

**IN THE UNITED STATES DISTRICT COURT**
**FOR THE DISTRICT OF DELAWARE**

| | |
|---|---|
| TQ DELTA, LLC,<br>Plaintiff,<br>v.<br>2WIRE, INC.<br>Defendant. | Civil Action No. 13-cv-1835-RGA |

**REBUTTAL EXPERT REPORT ON NON-INFRINGEMENT OF DR. KRISTA S. JACOBSEN FOR FAMILY 3 PATENTS**

[redacted]

[redacted]

VTU-R: the VTU-R must configure its interleaver, and the VTU-O must configure its deinterleaver, such that the actual end-to-end delay, $delay\_octet_{US,0}$, is no more than the value of $max\_delay\_octet_{US,0}$.

57. The delay_octet parameters and their relationships are tabulated below for convenience.

| **Delay** | **Definition** |
|---|---|
| $max\_delay\_octet_{DS,0}$ | maximum allowed end-to-end delay, in octets, resulting from the combination of the VTU-O's interleaver and the VTU-R's deinterleaver for the downstream latency path 0 |
| $delay\_octet_{DS,0}$ | actual end-to-end delay, in octets, that results from the combination of the VTU-O's configured interleaver and the VTU-R's configured deinterleaver for the downstream latency path 0<br><br>$delay\_octet_{DS,0} \leq max\_delay\_octet_{DS,0}$ |
| $max\_delay\_octet_{US,0}$ | maximum allowed end-to-end delay, in octets, that results from the combination of the VTU-R's configured interleaver and the VTU-O's configured deinterleaver for the upstream latency path 0 |
| $delay\_octet_{US,0}$ | end-to-end delay, in octets, that results from the combination of the VTU-R's configured interleaver and the VTU-O's configured deinterleaver for the upstream latency path 0<br><br>$delay\_octet_{US,0} \leq max\_delay\_octet_{US,0}$ |

58. G.993.2 states that the minimum amount of memory the VTU-O or the VTU-R must use to meet each of the delay_octet values is half of the specified delay. *See, e.g.*, *id.* at § 6.8.2 ("Each interleaver and each de-interleaver for each latency path requires at least $(delay\_octet_{[DS/US],[0]}/2)$ octets of memory to meet this delay.") (emphasis added). In other words, the values of $delay\_octet_{DS,0}$ and $delay\_octet_{US,0}$ establish only lower bounds on the amounts of memory that the VTU-R and VTU-O must actually use for interleaving and deinterleaving. Specifically, the VTU-R's deinterleaver requires at least $delay\_octet_{DS,0}/2$ of memory for deinterleaving and its interleaver requires at least $delay\_octet_{US,0}/2$ of memory for

[redacted]

interleaving. Similarly, the VTU-O's deinterleaver requires at least delay_octet$_{US,0}$/2 of memory for deinterleaving and its interleaver requires at least delay_octet$_{DS,0}$/2 of memory for interleaving.

59. Thus, once the VTU-O's and VTU-R's interleavers and deinterleavers have been configured, the following relationships hold:

- delay_octet$_{DS,0}$/2 = ***minimum*** *amount of memory in use* by VTU-O interleaver
- delay_octet$_{DS,0}$/2 = ***minimum*** *amount of memory in use* by VTU-R deinterleaver
- delay_octet$_{US,0}$/2 = ***minimum*** *amount of memory in use* by VTU-R interleaver
- delay_octet$_{US,0}$/2 = ***minimum*** *amount of memory in use* by VTU-O deinterleaver

60. G.993.2 states explicitly that the amount of memory actually used by a VTU-O or VTU-R to meet the specified delay_octet$_{DS,0}$ and delay_octet$_{US,0}$ values is implementation-specific. *See, e.g.*, *id.* ("Each interleaver and each de-interleaver for each latency path requires at least (delay_octet$_{x,p}$/2) octets of memory to meet this delay. The actual amount of memory used is implementation specific."). Thus, for example, to meet the aggregate interleaver/deinterleaver delay of delay_octet$_{DS,0}$, the memory used by the VTU-R to deinterleave the downstream latency path zero must be at least as large as half of the applicable end-to-end delay (*i.e.*, delay_octet$_{DS,0}$/2) in octets. Likewise, to meet the aggregate interleaver/deinterleaver delay of delay_octet$_{US,0}$, the memory used by the VTU-R to interleave the upstream latency path zero must be at least as large as half of the applicable end-to-end delay (*i.e.*, delay_octet$_{US,0}$/2) in octets. As G.993.2 makes clear, however, the VTU-R is free to use more memory than delay_octet$_{US,0}$/2 to interleave upstream latency path zero, and it is free to use more memory than delay_octet$_{DS,0}$/2 to deinterleave downstream latency path zero. As I discussed above, Dr. Modlin's Chapter 9 in Fundamentals explains that even memory-

[redacted]

optimized interleavers and deinterleavers use more than the theoretical minimum amount of memory for interleaving and deinterleaving, and implementations may use significantly more than the theoretical minimum amount of memory (e.g., to provide a simpler or more flexible implementation). *See, e.g.*, Fundamentals at pp. 262, 264. Therefore, simply knowing the value of $delay\_octet_{DS,0}$ or $delay\_octet_{US,0}$—or the downstream or upstream *I* and *D* values—is insufficient to determine how much memory the VTU-R is actually using, or has allocated, for, respectively, deinterleaving or interleaving.

61. The ***minimum total amount*** of memory the VTU-R must use to perform both interleaving and deinterleaving (assuming one latency path in each transmission direction) is $delay\_octet_{DS,0}/2 + delay\_octet_{US,0}/2$. G.993.2 at § 6.2.8.

62. As noted above, G.993.2 contemplates, but does not require, that a VTU-O or a VTU-R might use shared memory for interleaving and deinterleaving. Therefore, G.993.2 also specifies that the total aggregate delay for all interleaving and deinterleaving, in both the downstream and upstream directions and over all latency paths, must be less than or equal to a specified number of octets. *Id.* In particular, the total aggregate delay must not exceed the number of octets specified for the parameter "aggregate interleaver and de-interleaver delay (octets)" for the selected profile. *See id.* at § 6.1. This value is denoted as "MAXDELAYOCTET," and it sets a lower bound on the total amount of memory a VTU-O must have available for interleaving all downstream latency paths and deinterleaving all upstream latency paths, and a VTU-R must have available for interleaving all upstream latency paths and deinterleaving all downstream latency paths. For a VDSL2 connection having a single downstream latency path and a single upstream latency path, $max\_delay\_octet_{DS,0} + max\_delay\_octet_{US,0} \leq$ MAXDELAYOCTET. *Id.* at § 11.4.2.7.

[redacted]

63. G.993.2 is explicit that the value of MAXDELAYOCTET establishes a lower bound on the amount of memory each of the VTU-O and VTU-R must provide to meet the specified maximum aggregate interleaver and deinterleaver delay: "The ***minimum amount of memory required*** in a transceiver (VTU-O or VTU-R) to meet this requirement is MAXDELAYOCTET/2 octets. ***The actual amount of memory used is implementation specific***." *Id.* at § 6.8.2 (emphasis added). In other words, the amount of memory a VTU-R must provide to meet the maximum allowed total delay is at least half of the number of octets listed for the parameter "aggregate interleaver and de-interleaver delay (octets)" of the selected profile in Table 6-1, but the amount of memory actually provided may be larger.

64. Dr. Cooklev states, correctly, that "'max_delay_octet$_{DS,0}$' in field #8 of the O-PMS message specifies the maximum delay for the VTU-O interleaver/VTU-R deinterleaver, and 'max_delay_octet$_{US,0}$' in field #10 of the O-PMS message specifies the maximum delay for the VTU-R interleaver/VTU-O deinterleaver." Cooklev Report at ¶ 101 (emphasis added). He then concludes, incorrectly, that "the maximum number of bytes of VTU-R deinterleaver memory is specified as one-half of max_delay_octet$_{DS,0}$ and the maximum number of bytes of VTU-R interleaver memory is specified as one-half of max_delay_octet$_{US,0}$." *Id.* As I explained above, this conclusion is wrong. If the value of max_delay_octet$_{DS,0}$ in the O-PMS message specifies anything to the VTU-R about an amount of memory to be allocated to a deinterleaver, it specifies only a ***minimum amount of memory*** that must be available to the deinterleaver to meet the maximum allowed delay. Likewise, if the value of max_delay_octet$_{US,0}$ in the O-PMS message specifies anything to the VTU-R about an amount of memory to be allocated to an interleaver, is specifies only a minimum amount of memory that must be available to the interleaver to meet the maximum allowed delay. Contrary to Dr.